Chip-scale THz Spectrometer, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

We propose to revolutionize the field of frequency-domain terahertz (THz) spectrometers by developing ~2 cm^3 wide-band spectrometer with improved frequency accuracy, resolution and stability. Integration will also provide significant SWaP-C advantage compared to present solution allowing deployment in small spacecraft platforms and other applications where low SWaP is crucial.

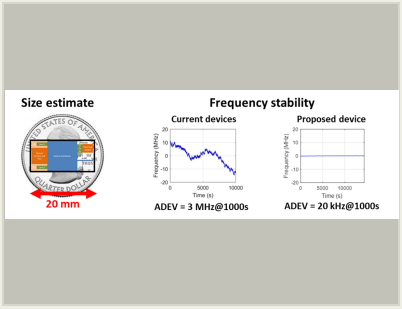
Compared to presently available frequency-domain THz spectrometers, we expect significant improvements as follows:

- > 10x weight reduction
- > 500x size reduction
- > 5x cost reduction
- > 1000x frequency accuracy improvement
- > 10x frequency resolution improvement
- Guaranteed long-term stability with built-in calibration until end-of-life (EOL)

Anticipated Benefits

The T8.02 Photonic Integrated Circuits topic specifically calls for integrated photonic sensors that include as example: Terahertz spectrometer. We propose to revolutionize the field of frequency-domain THz spectrometers by developing ~2 cm^3 chip-scale spectrometer. The core of the spectrometer is a stable THz signal generator. Said generator is a crosscutting technology that can be used in mm-wave or THz communication systems as well as in sensing application as the envisioned THz spectrometer.

Terahertz spectroscopy can be used, among other things, for: explosive detection, narcotics detection, pharmaceutical quality control and tissue classification. This makes it very interesting for many government agencies such as DoD, DHS, EPA and HHS. With SWaP-C improvements, we can expect such sensors to be more widely deployed. In terms of non-government markets, the pharmaceutical industry could be one of the early adopters of said technology.



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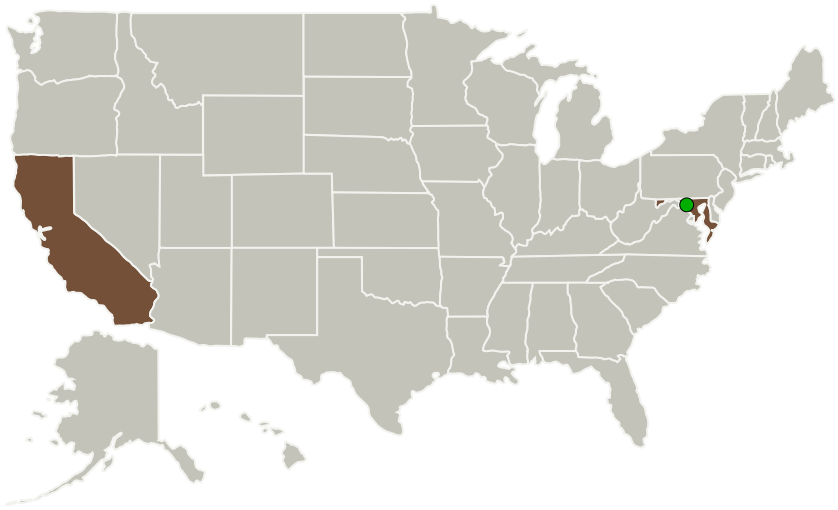
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nexus Photonics, LLC	Lead Organization	Industry	Santa Barbara, California
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
University of California-Santa Barbara(UCSB)	Supporting Organization	Academia Hispanic Serving Institutions (HSI)	Santa Barbara, California

Primary U.S. Work Locations	
California	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nexus Photonics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

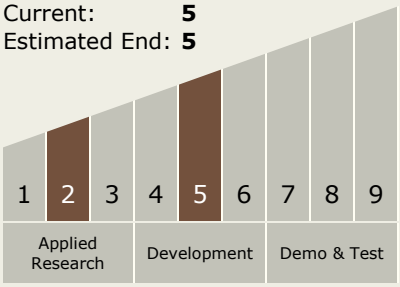
Carlos Torrez

Principal Investigator:

Tin Komljenovic

Technology Maturity (TRL)

Start: **2**
Current: **5**
Estimated End: **5**



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Project Transitions

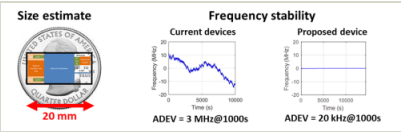
July 2018: Project Start

August 2019: Closed out

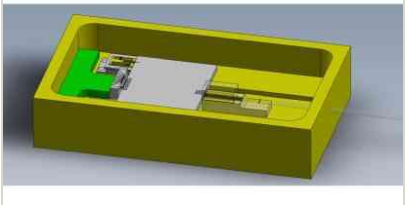
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141306)*

Images



Briefing Chart Image
Chip-scale THz Spectrometer, Phase I
(https://techport.nasa.gov/image/128029)



Final Summary Chart Image
Chip-scale THz Spectrometer, Phase I
(https://techport.nasa.gov/image/128925)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System